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NATIONAL ELECTRICAL EQUIPMENT CONSTRUCTION IN THE FIRST POSTWAR FIVE-YEAR PLAN

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[Figures referred to herein are not reproduced but are available in the original document at CIA.]

Before the Revolution, Russia was wholly dependent on the electrical industries of foreign countries for the production of precise instruments for electrical measurements. Various types of switchboard installations were assembled in Russia from parts which were imported from abroad. Production of laboratory electric meters was nonexistent in Russia.

Lenin's electrification plan envisaged huge projects for reconstruction of the national economy by the extensive introduction of electrical technology in all fields of industry. This caused a huge demand for electric meters, and necessitated the establishment of a national industry for instrument construction.

Along with the establishment of an instrument-construction industry, it became necessary to develop the classification of instruments, to work out a method for checking and testing them, and to establish a network in the country for checking the accuracy of the electrical meters.

All this predetermined the great demand for testing, calibrating, and laboratory electric meters, and special testing equipment.

During the Five-Year Plans, new instrument-construction plants were built, personnel was trained, standards for the basic instruments were developed and introduced, and production of electric meters in considerable quantities was organized.

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However, the vigorous growth of the entire industry and the extensive introduction of electrical technology throughout the national economy outstripped the growth of the instrument-construction industry. With this, instruments possessing a high degree of accuracy, which were needed by plant, educational, and scientific research laboratories were not produced in sufficient quantity, and the demand for such instruments was not met in full.

In the prewar years, new factories began to enter the system, and they had to take care of a large part of the country's demand for instruments.

World War II brought about large dislocations of the instrument-construction plants, and great changes in the nature of their production.

The relocation of part of the instrument factories, and the necessity to supply the front caused a severe curtailment in the output of precise electric meters.

On 9 February 1946 Comrade Stalin, in his speech to the voters of the Stalin Electoral District in Moscow, pointed out a number of problems confronting the Soviet people. He particularly stressed the necessity for substantial development of scientific research institutions and enlargement of the scope of scientific research work. These designations from our leader also define the basic problems confronting the electrical-instrument construction industry.

Electrical technology and electrotechnical measurements have so penetrated all fields of scientific research--mechanics, thermotechnology, geology, medicine, and biology--that it is difficult to imagine a laboratory which does not possess a great number of high-precision electric meters for various specific purposes.

To solve the problem of providing all the varied branches of technology with laboratory electric meters, the new Five-Year Plan envisaged increasing instrument production seven times in comparison with 1940. In connection with this, the electrical-instrument factories were faced with the following problems: (1) modernization of previously used electric meters, (2) development and use of instruments not previously produced in domestic plants, (3) introduction of new technology in our plants, and use of special materials and alloys, which are being introduced extensively in the contemporary electrical-instrument industry, (4) adoption of assembly-line methods of production, (5) restoration and reconstruction of factories which had suffered from the war and occupation, and (6) training technical personnel who are not only capable of maintaining the present production, but also of advancing the development of the instrument industry.

Not all of the problems have been solved, but the course has been set for development of individual plants, and initial successes have been attained in the use of precise electrical instruments and in laying the foundation for further development of the instrument industry.

A new type of megohmmeter for 500 volts and 500 megohms has been developed in the plant directed by A. M. Pamakiy. In the new design, a generator with a magnetic rotor is used instead of the old inductor. This simplified production of this basic unit of the instrument and reduced its cost substantially. The instrument case, which is plastic, is considerably cheaper and simpler in comparison with wooden or cast cases. Conversion of production of this instrument to an operational assembly permitted a sharp reduction in labor expenditure and production cost.

In the indicating galvanometer, Type M-122, developed by the plant directed by M. Z. Kotlyarevskiy, the use of magnets from the alloy magniko /sic/ permitted construction of an instrument with a sensitivity of 0.1-0.2 · 10^{-6} amperes. Thanks to the use of a removable plastic case and series-produced standard parts, the instrument was technically simple, and went into serial output in a short time. The galvanometer may also be manufactured with sensitivities of 0.3-0.5 · 10^{-6} amperes and 4.4 · 10^{-6} amperes.

The multirange 0.5-ampere constant-current laboratory instrument shown in Figure 2 was utilized in A. M. Kamskiy's plant for measuring and calibrating laboratory work and for scientific research. The measurement ranges of the instrument are: in current, 0.15, 0.30, 0.75, 1.5, 3, 7.5, 15, and 30 amperes (with the use of an external shunt, this range may be increased to 300 amperes); in voltage, 0.045, 0.075, 0.15, 0.30, 3, 7.5, 15, 30, 75, 150, and 300 volts. With the aid of a multiplying resistor, it is possible to measure up to 1,500 volts. On the basis of this instrument, an experimental set of millivolt-milliammeters was made with the following measurement ranges: in current, 0.15 - 0.5 - 1.5 - 5 - 15 - 50 milliamperes, and in voltage, 15 - 30 - 150 - 300 - 1,500 millivolts.

The portable measuring kit (meskofer) shown in Figure 3 was produced by the plant directed by O. I. Irashchenko. In it are the following meters: (1) an astatic ammeter, range 2.5-5 amperes of the 0.5 class; (2) an astatic voltmeter, range 150-300 volts of the 0.5 class; (3) an astatic wattmeter, range 150 volts and 5 amperes of the 0.5 class; (4) a universal current transformer of the 0.2 class for 15-30-50-100-200-300-600 amperes; (5) a multiplying resistor for the voltmeter to measure 600 volts, and (6) a multiplying resistor for the wattmeter for measurements up to 300 and 600 volts.

The above instruments extend the possible ranges of measurement considerably, and guarantee the execution of measurements that are encountered in production and laboratory practice.

The construction of a precision 6-decade resistance box with an adjustment precision of 0.2 percent (Figure 4) was developed in the plant directed by I. A. Fillimonov.

Six decades of resistances allow any resistance from 0.1 to 99,999.9 ohms to be obtained.

A 4-decade resistance box is shown in Figure 5 and a Wheatstone bridge is shown in Figure 6. These are made up on the basis of the 6-decade box by utilizing the parts and units of that box. The 4-decade box is made up of resistances ranging from 1 to 99.0 ohms.

The Wheatstone bridge for measuring resistances up to 100,000 ohms with an accuracy of 0.5 percent has a built-in galvanometer with a sensitivity of 10^{-6} amperes for each division. The bridge may be connected with an external mirrored galvanometer, which allows greater accuracy in measurement.

A change-over switch is provided which allows the instrument to be used to check for breaks in circuits by setting the bridge according to the Murre (Murray ?) or Varleya (Varley ?) diagrams.

Using parts and units from the resistance box, the manufacture of the bridge was carried out in a comparatively short time, and the serial production of this instrument was organized with only a small expenditure of time and facilities.

Another group of high-precision instruments was developed in the same factory by exploitation of the following parts: (1) a Tomson-Wheatstone bridge for measuring resistances from 10^{-6} to 10^{6} ohms with an accuracy of 0.05 percent, (2) a high-resistance potentiometer for measuring from 10 millivolts to 2.1 volts in 10-millivolt steps with an accuracy of 0.02 percent and with a voltage divider for 21, 210, and 1,050 volts, (3) a low-resistance potentiometer with an elimination of the e.d.s. effect for measuring with an accuracy of 0.02 percent. The potentiometer has four switches for measuring from 100 millivolts to 1.1111 volts in 100-millivolt steps; from 10 millivolts to 0.11111 volts in 10-millivolt steps; from 1 millivolt to 0.011111 volts in 1-millivolt steps; and from 0.1 millivolt to 0.0011111 volts in 0.1-millivolt steps. The dimensions of the instrument are: 610 by 290 by 200 millimeters.

A high-resistance box with a range of one megohm was built from parts of these instruments. It consisted of one decade, having 20 positions, each of 50,000 ohms.

Comrade Damskiy's plant worked out the construction of a simplified four-train, magnetoelectric portable oscillograph (Figure 7); the oscillograph simultaneously records four processes on film. The complete eight-train oscillograph from the same factory is shown in Figure 8.

The portable, small-dimension Wheatstone bridge (Figure 9) was developed in one of our factories. The bridge is designed for measuring resistances from 0.5 to 50,000 ohms with an accuracy of 2 percent. A galvanometer with sensitivity of $1 \cdot 10^{-6}$ amperes is built into the plastic case. The power supply comes from a built-in pocket battery.

The use of a number of units and parts from other serial products put out by the factory, and the extensive use of plastics permitted the organization of the instrument's serial production in a short time.

Contemporary mass-production methods must be introduced into instrument construction. The country needs cheap, high-quality instruments in large quantities, quantities which correspond to the scope of scientific research work which followed from Comrade Stalin's speech before the electors on 9 February 1946. This cannot be secured without the utilization of all the achievements of new technology, and the application of contemporary methods of production organization.

All the achievements of new technology (new materials and alloys, high-frequency heating and tempering, electric-spark processing, etc.) may be introduced in the instrument industry with great effect, along with the organization and inculcation of assembly techniques of production.

An increase in the quality of the instruments and a decrease in their cost depends on standardization of units and parts. All the instrument factories use similar and, in some cases, identical parts: moment springs, magnets, cores, etc. All these parts should be standardized.

On the whole, the work of the instrument-construction industry in the first postwar years has started to obtain a substantial quantity of laboratory instruments. The successful implementation of the postwar Five Year Plan by the instrument-construction factories will allow the country to be supplied with new, precise electric meters which will compare favorably with the best contemporary meters made.

List of Photo Captions

Figure 1. Megohmmeter 500 Volts, 500 Megohms
Figure 2. The Multirange Laboratory Instrument
Figure 3. The Portable Measuring Kit (Mershofer)
Figure 4. Resistance Box
Figure 5. Four-Decade Resistance Box
Figure 6. The Universal Wheatstone Bridge
Figure 7. The Four-Train Oscillograph
Figure 8. The Eight-Train Oscillograph
Figure 9. The Small-Dimension (Compact) Wheatstone Bridge

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